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International Earth Science Constellation Mission Operations Working Group

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Aqua and Aura 2015 MLT Prediction Changes

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 - Updated Aqua plan vs. Updated Aura plan

- Change in Aqua MLT prediction was caused by three factors
 - The Aqua IAM dates were changed causing a minor excursion of the operational MLT requirement
 - Starting tank pressure, which could have been mitigated with DMUs at the descending node
 - TSF/Duty Cycle trending changes

- Planned start date of the 2015 Aqua and Aura IAM series moved 1 week back
 - Changed to accommodate a Constellation Science Meeting
 - Allow other missions to perform inclination burns prior to 2015 Spring MOWG.
- Re-planning caused the small excursion outside of the desired operational MLT limits for Aqua and Aura (slide 5/slide 11).
 - Re-planning occurred before the 2014 Fall MOWG
 - Excursion was approved by the Aqua/Aura mission director during re-planning

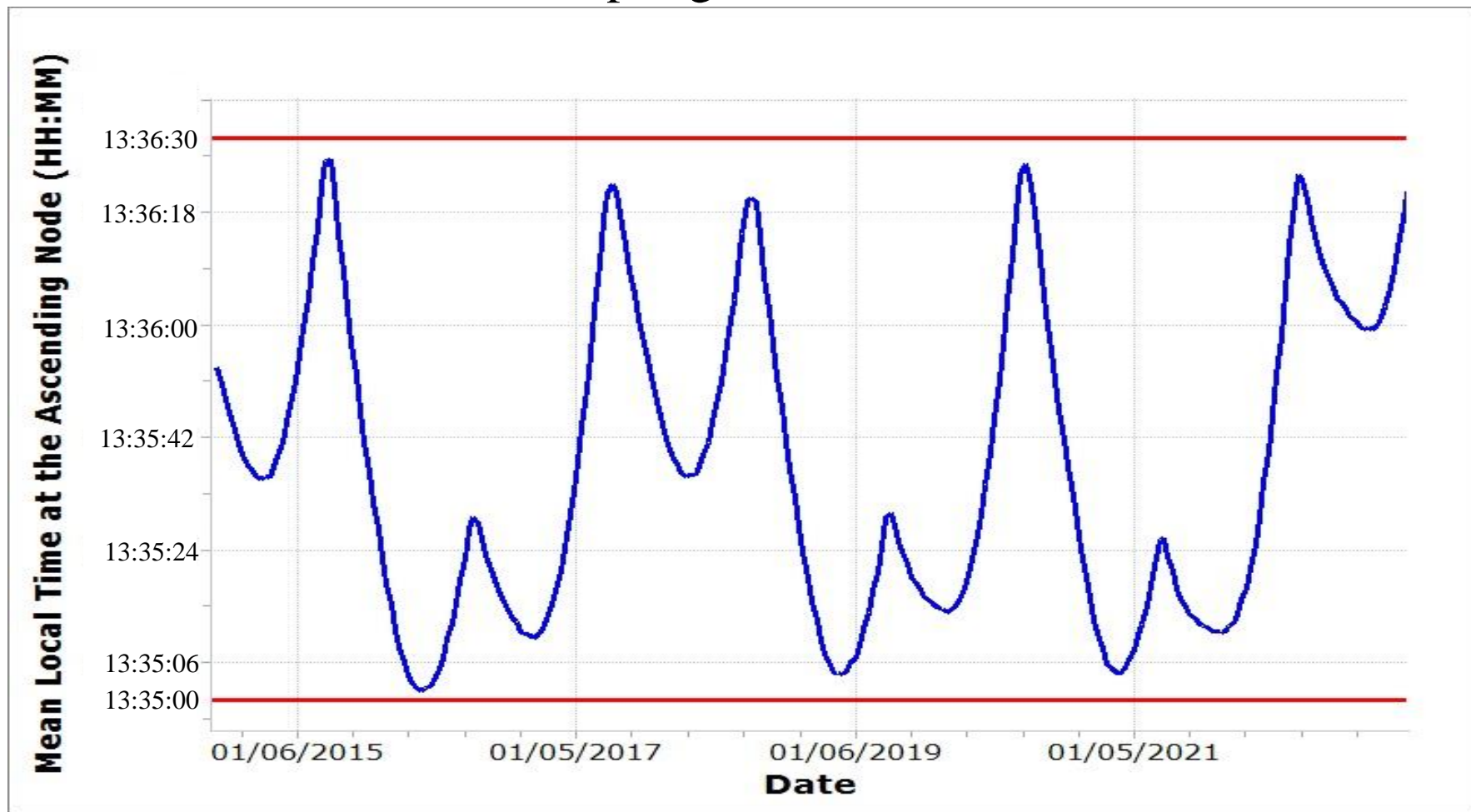
- Reconstruction of the 2015 Aqua IAM series, derived from the 2014 Aqua lifetime analysis, revealed a discrepancy in the achieved delta-INC. Further investigation revealed:
 - Lifetime planning used pre-2014 IAM tank pressures. This resulted in a total delta-INC Aqua was not capable of achieving due to a 550 second burn limitation
 - New duty cycle and thrust scale factor trending introduced midway through the 2014 Aqua IAM series were not considered.
- The predicted MLT difference grew from 5 sec with the pressure discrepancy to 13 sec with the new tank pressure value and updated trending method.

- To account for the differences, Aqua has:
 - Introduced additional inclination change by changing the target yaw angle to -82.1° , which has been a yaw angle range used historically, to achieve a closer predicted delta-INC value presented at the 2014 Fall MOWG (slide 9).
 - Performing no-slew maneuvers at the descending node to correct for MLT difference was originally considered but would be insufficient to adjust the 13 second difference

As a result, Aqua and Aura were able to maintain their mission requirements with the above changes to the 2015 Spring IAM series.

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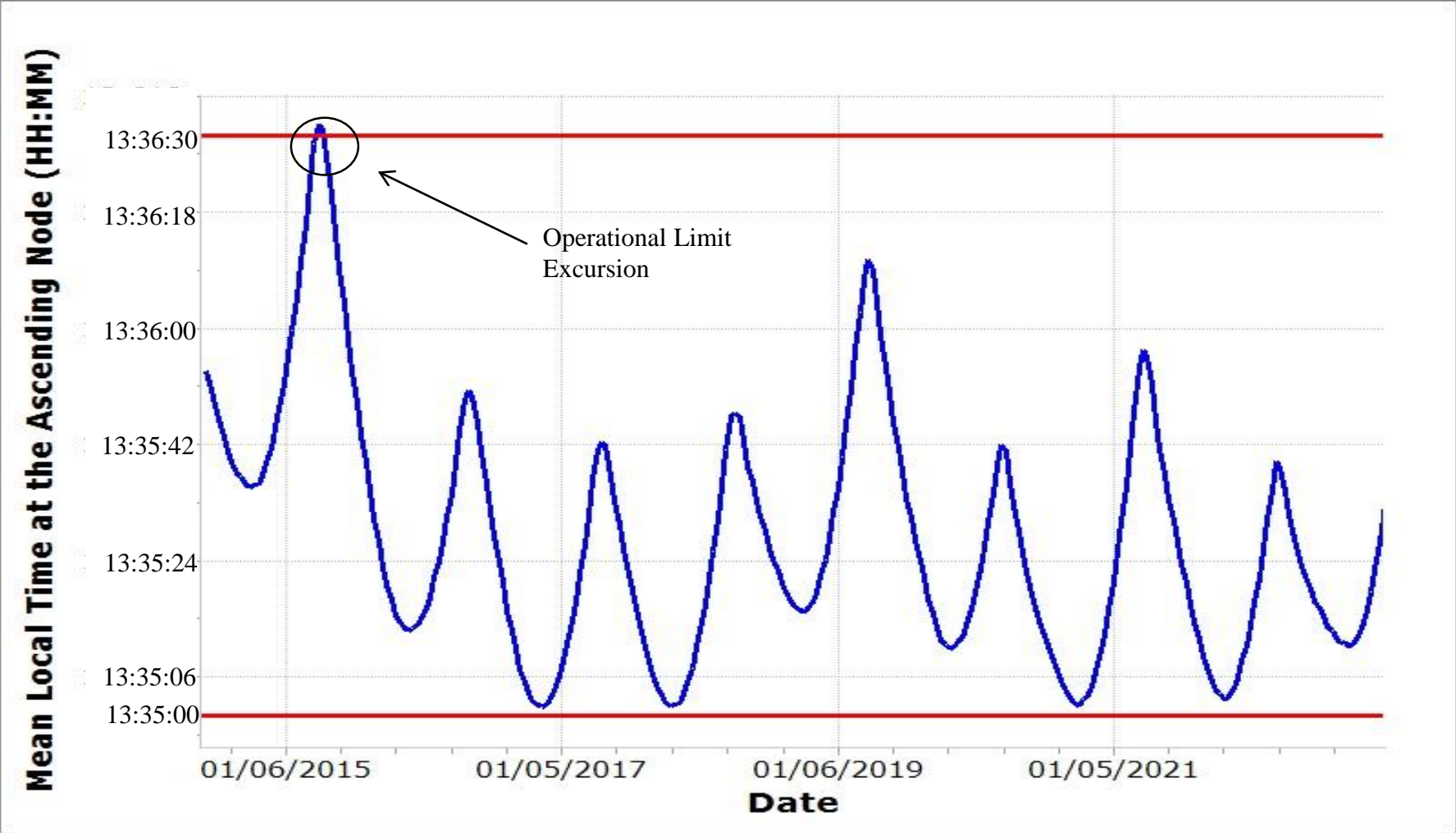
Aqua Long-Term MLT Predictions with 2014 Spring MOWG IAM Dates



Aqua's MLT requirement is $13:30 \pm 15$ minutes. The mission has agreed to fly within tighter bounds for improved science data collection, as well as, more repeatability of delta-INC maneuvers from year to year.

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Aqua Long-Term MLT Predictions with 2014 Fall MOWG IAM Dates

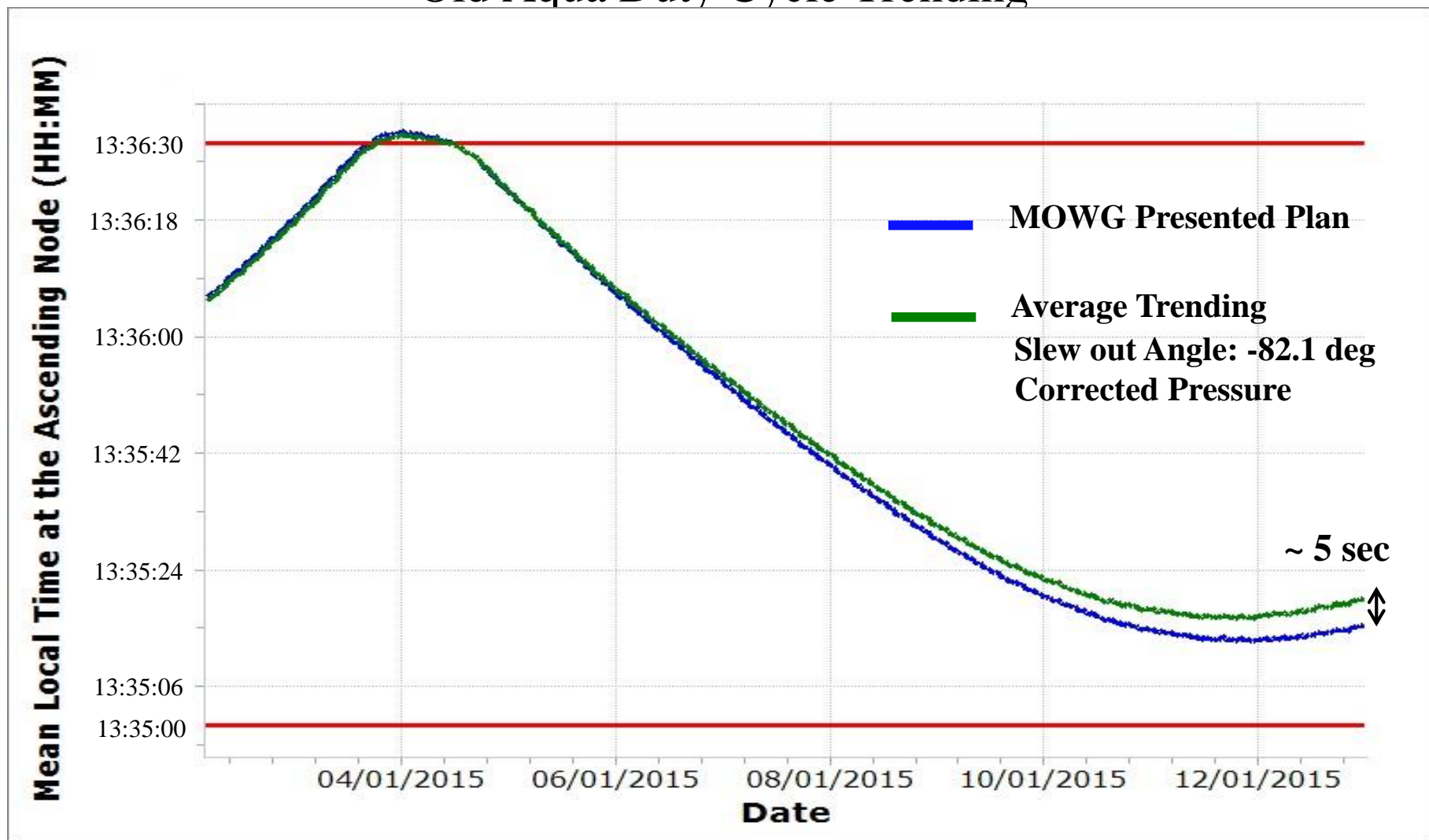


Moving the original start date of 2015 IAM Series introduced a small excursion of the desired MLT limits (approved by mission director before Fall 2014 MOWG)

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Planned vs. Achievable MLT

Old Aqua Duty Cycle Trending

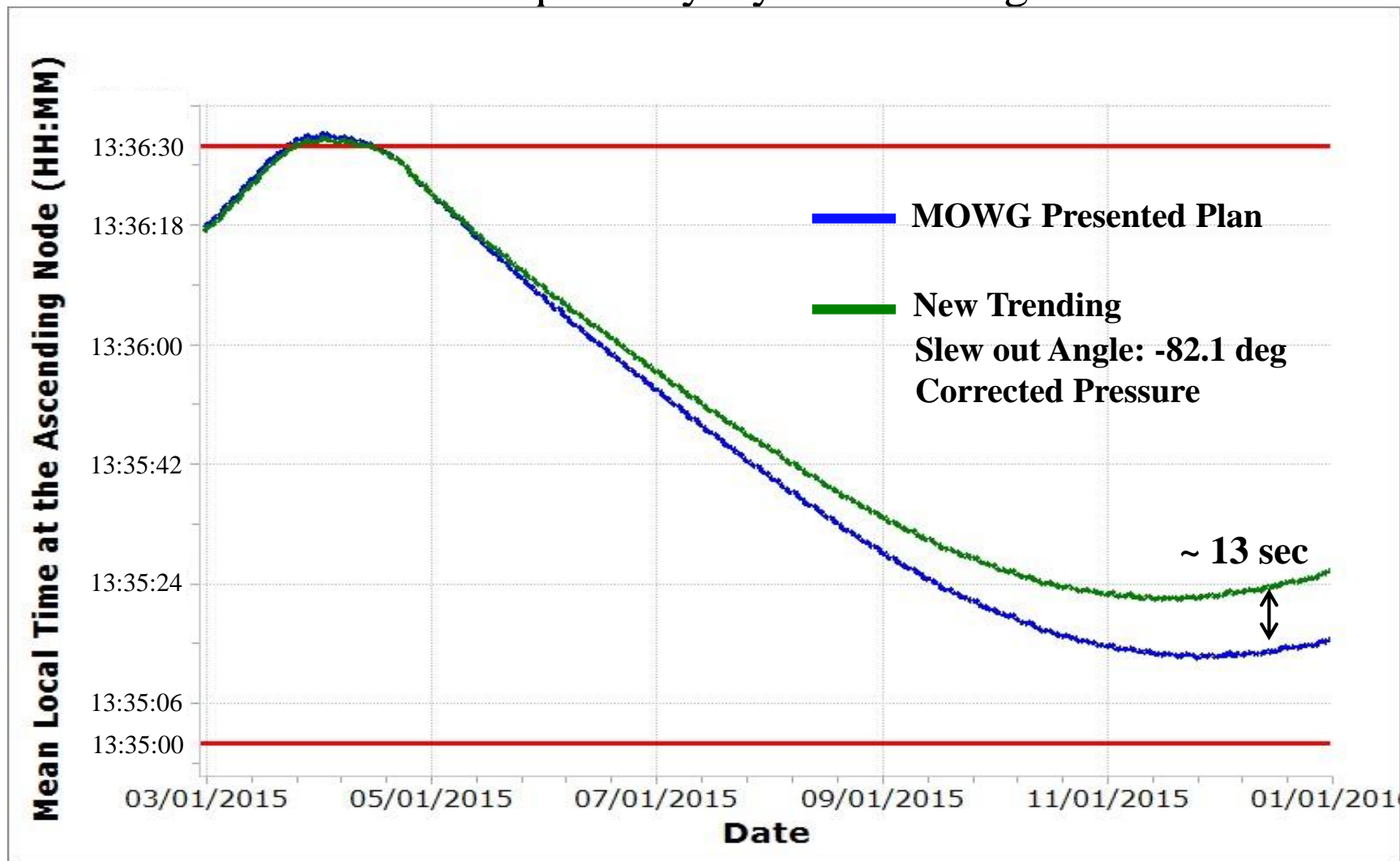


Aqua will have a maximum MLT difference of 5 seconds after utilizing the correct tank pressure.
4/8/2015

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Planned vs. Achievable MLT

New Aqua Duty Cycle Trending



The maximum MLT difference is predicted to be 13 seconds after utilizing the new trending method.

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Predicted Results Comparison

2014 Fall MOWG Presented Predictions

Inc #	Day of Week	Date	Burn Duration (sec)	Delta - Inc (deg)	Delta - V (m/s)	Delta - RAAN (deg)	Final Fuel Mass (kg)	PreMan Pressure (psi)
43	Wed	18-Mar-15	550	-0.0092	1.214	0.00103	90.946	205.4753
44	Wed	25-Mar-15	550	-0.0092	1.210	0.00053	88.851	204.3107
45	Wed	1-Apr-15	550	-0.0091	1.205	0.00005	86.775	203.1645
46	Wed	15-Apr-15	550	-0.0091	1.200	-0.00087	84.707	202.0408
47	Wed	22-Apr-15	550	-0.0089	1.195	-0.00125	82.666	200.9344
			Totals:	-0.0454	6.025	-0.00051	-10.384	-5.7376

Final Updated Predictions with Adjusted Angles (provided to MOWG members in Feb 2015)

Inc #	Day of Week	Date	Burn Duration (sec)	Delta - Inc (deg)	Delta - V (m/s)	Delta - RAAN (deg)	Final Fuel Mass (kg)	PreMan Pressure (psi)
43	Wed	18-Mar-15	550	-0.0088	1.167	0.00099	90.768	199.4869
44	Wed	25-Mar-15	550	-0.0088	1.162	0.00051	88.652	198.3602
45	Wed	1-Apr-15	550	-0.0088	1.158	0.00005	86.546	197.2512
46	Wed	15-Apr-15	550	-0.0087	1.152	-0.00084	84.449	196.1595
47	Wed	22-Apr-15	550	-0.0086	1.147	-0.00123	82.362	195.0414
			Totals:	-0.0437	5.787	-0.00052	-10.531	-5.5904

Differences	-0.0017	0.2380	0.000009	0.1471	-0.1472
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Aura vs. Aqua MLT Requirements

Aqua New Trending with Corrective Node DMUs



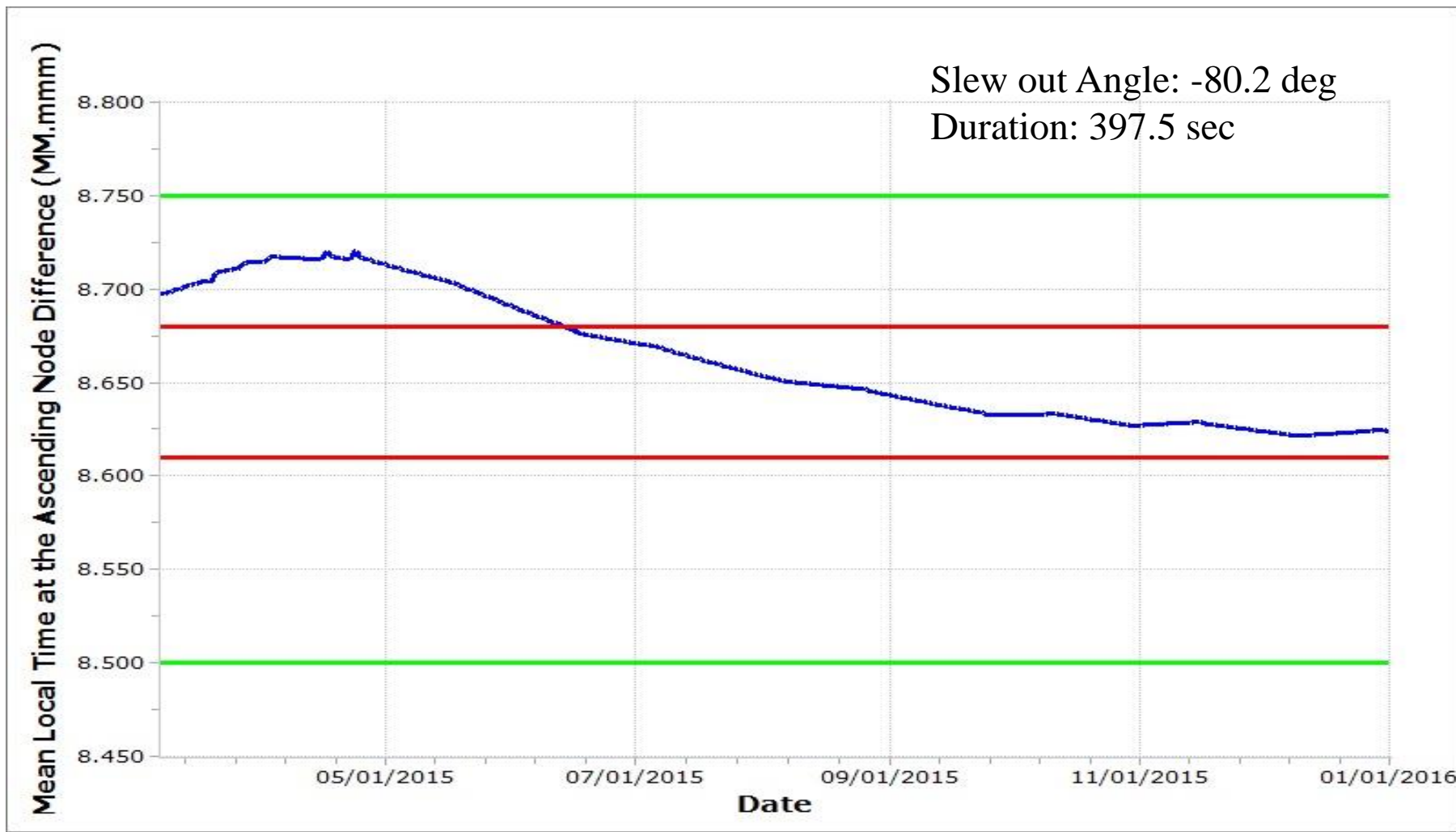
Aura IAM planned off the original CCS Aqua predictive ephemeris delivered to A-Train

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Aura vs. Aqua MLT Requirements

New Aura Plan



New Aura IAM planned off the updated CCS Aqua predictive ephemeris delivered to A-Train

4/8/2015

Summary

- Changing the original 2015 IAM Series dates caused a small excursion of the desired Aqua MLT limits.
- The pressure error, coupled with the decrease in predicted efficiency due to the updated duty cycle and TSF trending, Aqua was not able to fully correct the MLT difference using descending node DMUs.
- Aura will be able to maintain its required MLT separation from Aqua with minor changes to the burn duration of each Aura IAM.

Even with the issues involved in planning the 2015 IAM Series, Aqua and Aura will both maintain its orbit requirements.



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Questions?